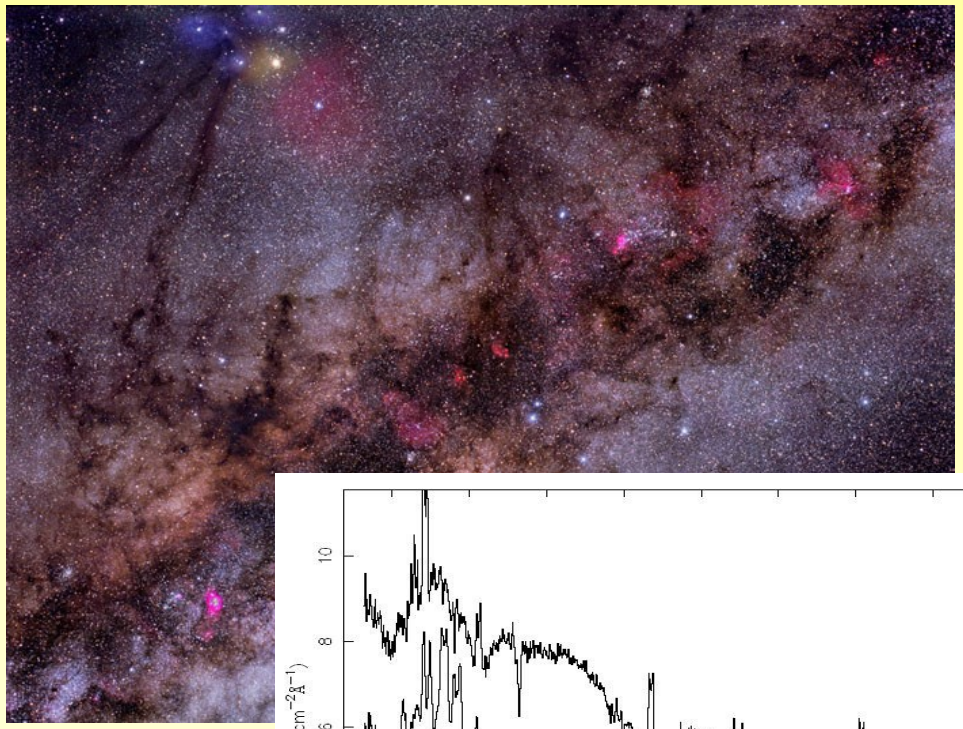
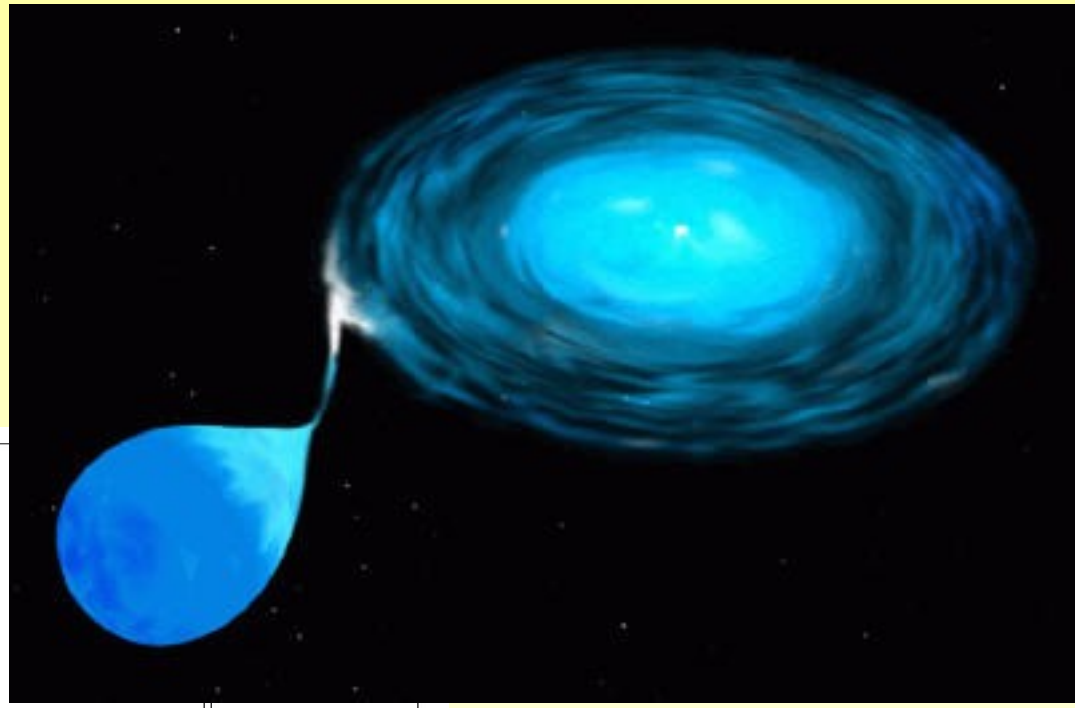
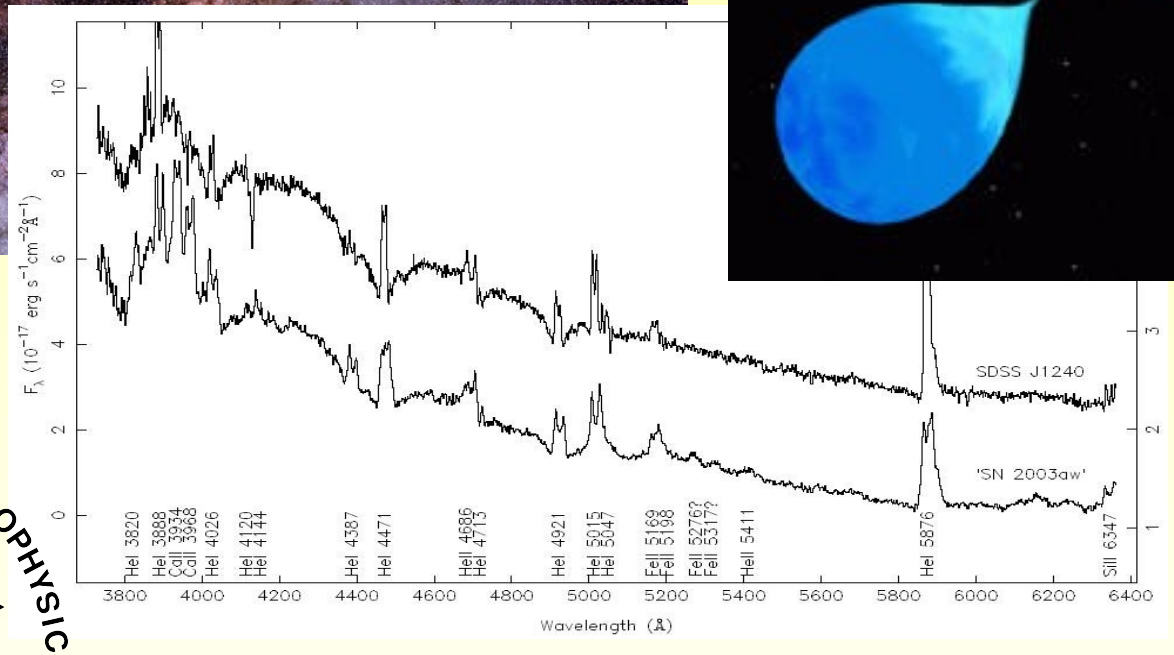
On the Hunt for more AM Cvn stars

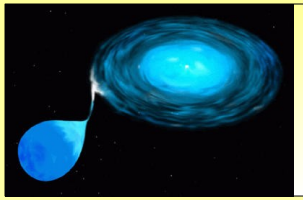






Paul Groot

CoIs: Gijs Roelofs, Gijs Nelemans, Danny Steeghs, Tom Marsh, Patrick Woudt

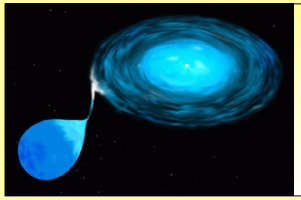


Current Situation

We know of 22 systems:

Name	P_{orb} (min)	Name	P_{orb}(min)
HM Cnc (RXJ0806+15)	5.4	SDSSJ1240-01	37.4
V407 Vul (RXJ1914+24)	9.5	*SDSSJ0804+16*	*44.5*
ES Cet	10.4	SDSSJ1411+48	46.0
AM CVn	17.1	GP Com	46.6
HP Lib	18.4	SDSSJ1552+32	56.3
CR Boo	24.5	CE 315	65.1
KL Dra	25.0	2QZ1427-01	36.6 (sh)
V803 Cen	26.6	SDSSJ0129+38	?
SDSSJ0926+36	28.3	SDSSJ1208+35	?
CP Eri	28.4	SDSSJ2047+00	?
V406 Hya (SN 2003aw)	33.8	SNF20060524-042	?

Dark Green: Direct Impact
Dark Brown: High state, stable systems
Dark Blue: Outbursting systems
Dark Red: Low state, stable systems
Black: unknown



Increasing numbers

> Resolution 1: *Let's do better in the coming three years...*

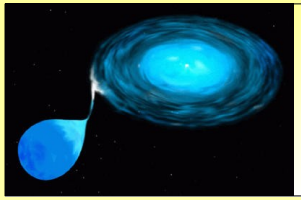
- Number of systems at 1st AM CVn workshop in 2005: 18[a]
- Number of systems at 2nd AM CVn workshop in 2008: 22
- Number of systems at 3rd AM CVn workshop in 2011: ??

New systems since 2005: SDSS J2047, SNF2006, SDSS J1208+35, SDSS J0804+16

> Resolution 2: *Let's do this in a homogeneous way*

- For modelling purposes: obtaining them homogeneously is as important as increasing numbers

[a] See contribution Brian Warner to 2005 workshop proceedings



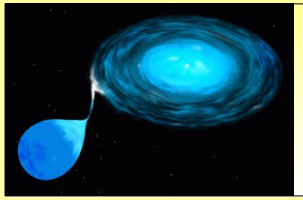
Sloan Survey

Sloan survey most prolific in providing new systems

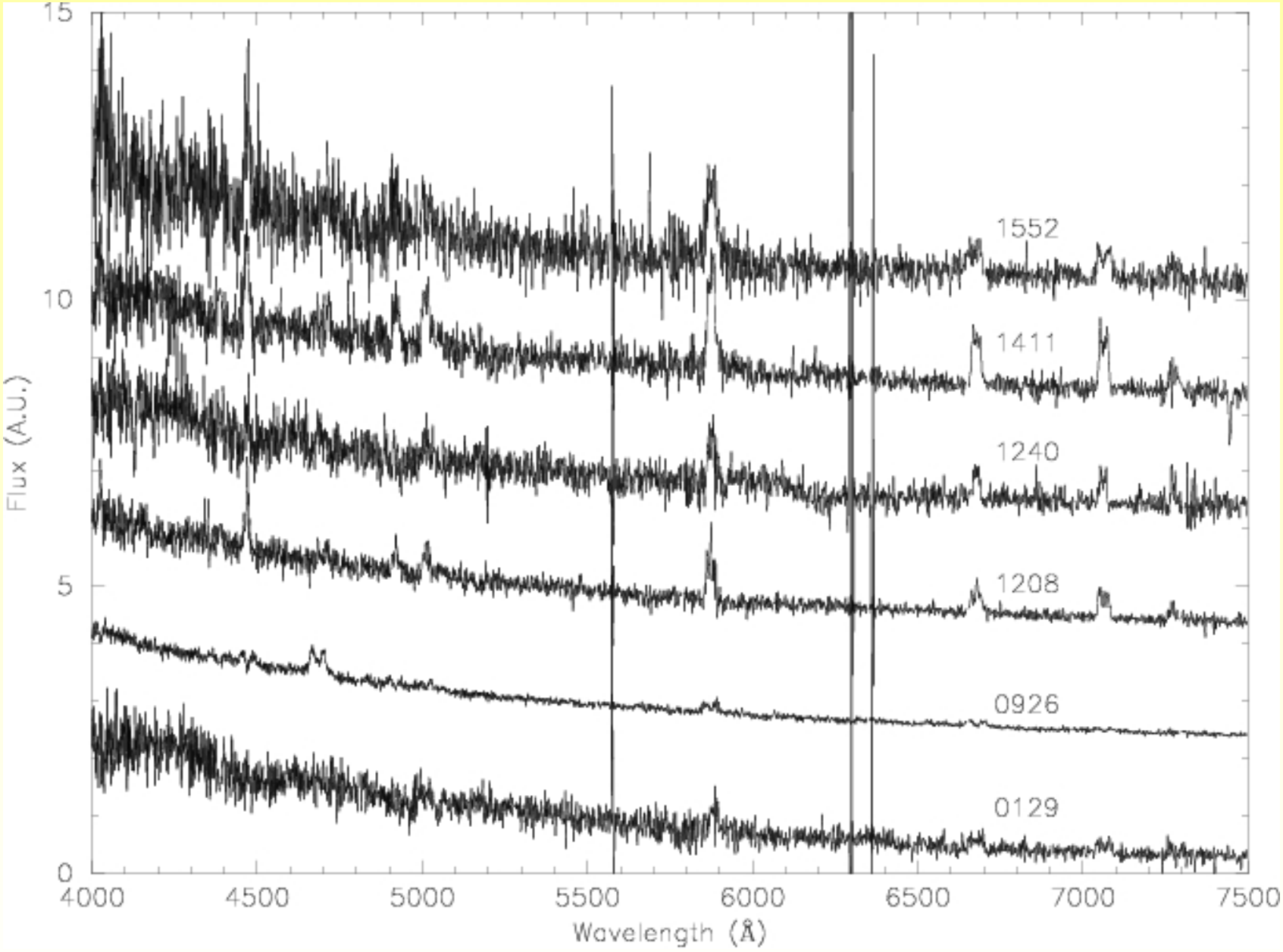
- Six systems from serendipitous spectroscopy

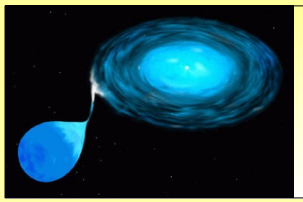
Roelofs et al., 2005, Anderson et al. 2005, 2008

- All identified by their helium emission lines



Sloan Survey





Space Density

Homo ty
deriva

& Groot, 2007

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Result

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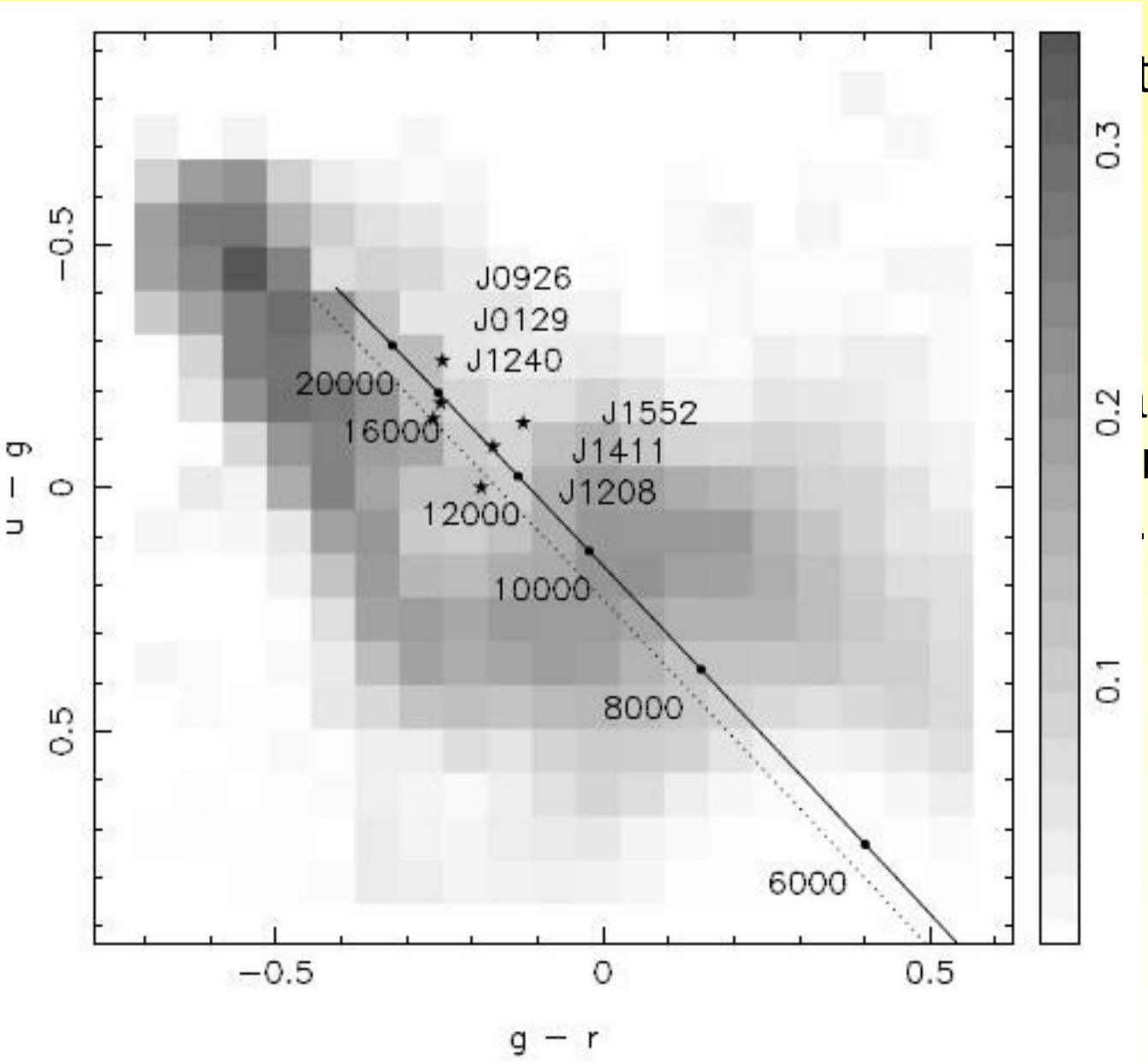
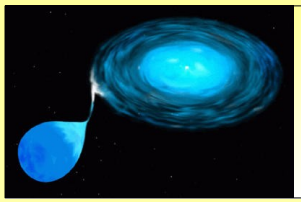


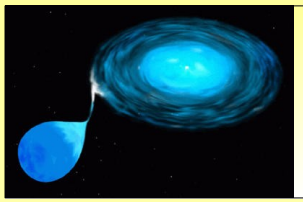


Results of/Predictions for Sloan

Model	Modelled # ($N'_{\rm spec}$)	Total in SDSS-I ($N_{\rm phot}$)	Modelled ρ'_0 (pc^{-3})	Observed ρ_0 (pc^{-3})	Observed σ (deg^{-2})
Optimistic	107	52	2.6×10^{-5}	1.5×10^{-6}	6.5×10^{-3}
Pessimistic	12	67	6.2×10^{-6}	3.2×10^{-6}	8.4×10^{-3}
He star only, optimistic	16	67	8.8×10^{-6}	3.4×10^{-6}	8.4×10^{-3}
He star only, pessimistic	11	68	5.9×10^{-6}	3.3×10^{-6}	8.5×10^{-3}
WD only, optimistic	91	50	1.7×10^{-5}	1.1×10^{-6}	6.2×10^{-3}
WD only, pessimistic	0.85	57	2.4×10^{-7}	1.7×10^{-6}	7.1×10^{-3}

Table 1. Observed space densities of AM CVn stars for different assumptions regarding their populations; the observed ρ_0 is obtained by multiplying the modelled ρ'_0 by $N_{\rm spec}/N'_{\rm spec}$ where $N_{\rm spec} = 6$. 'Optimistic' and 'pessimistic' models from Nelemans et al. (2001) with the Galactic model of Nelemans et al. (2004). The total $N_{\rm phot}$ is the number of emission-line AM CVn stars in the SDSS-I photometry down to $g_{\rm max} = 21$. The measured surface density σ down to $g = 21$ holds for Galactic latitudes $b \gtrsim 30°$. The observed ρ_0 and σ are accurate to an estimated factor of 2.

Total number of AM CVn stars in Sloan: ≥ 50



Predictions from/for Sloan

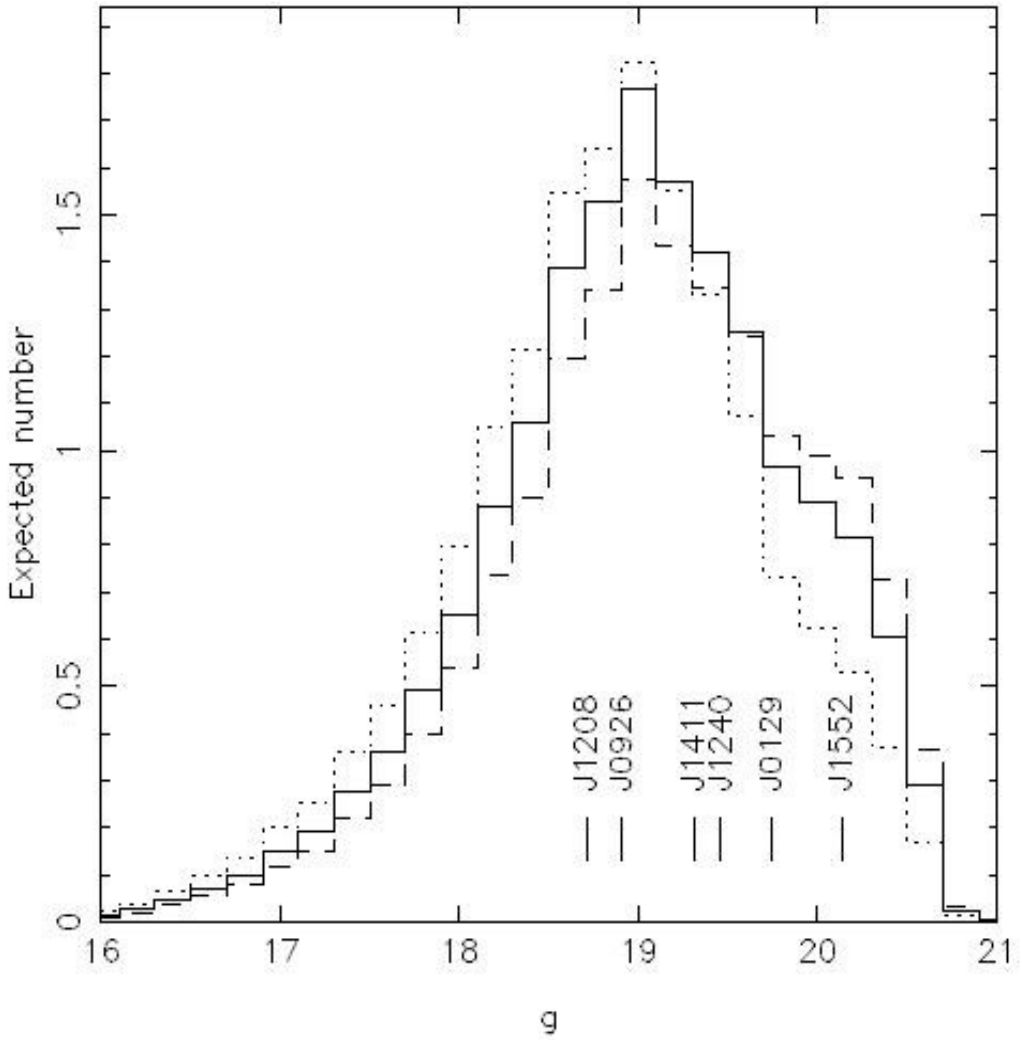


Figure 5. Modelled distribution of spectroscopically identified AM CVn stars in SDSS-I as a function of apparent magnitude g, in the *pessimistic* model. The dotted, solid and dashed lines represent model population scale heights of 200, 300 and 400 pc, respectively.

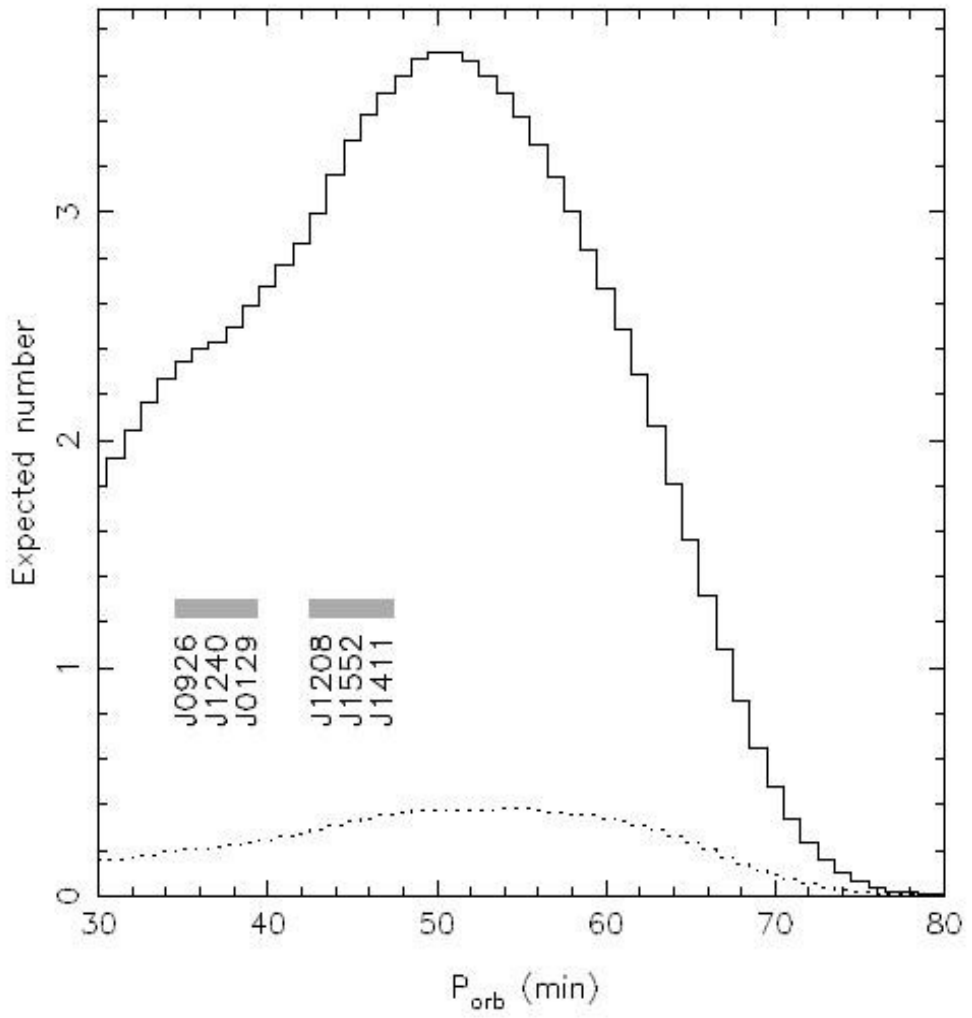
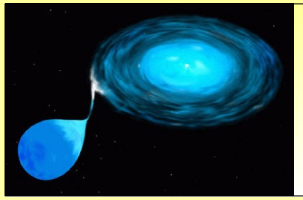
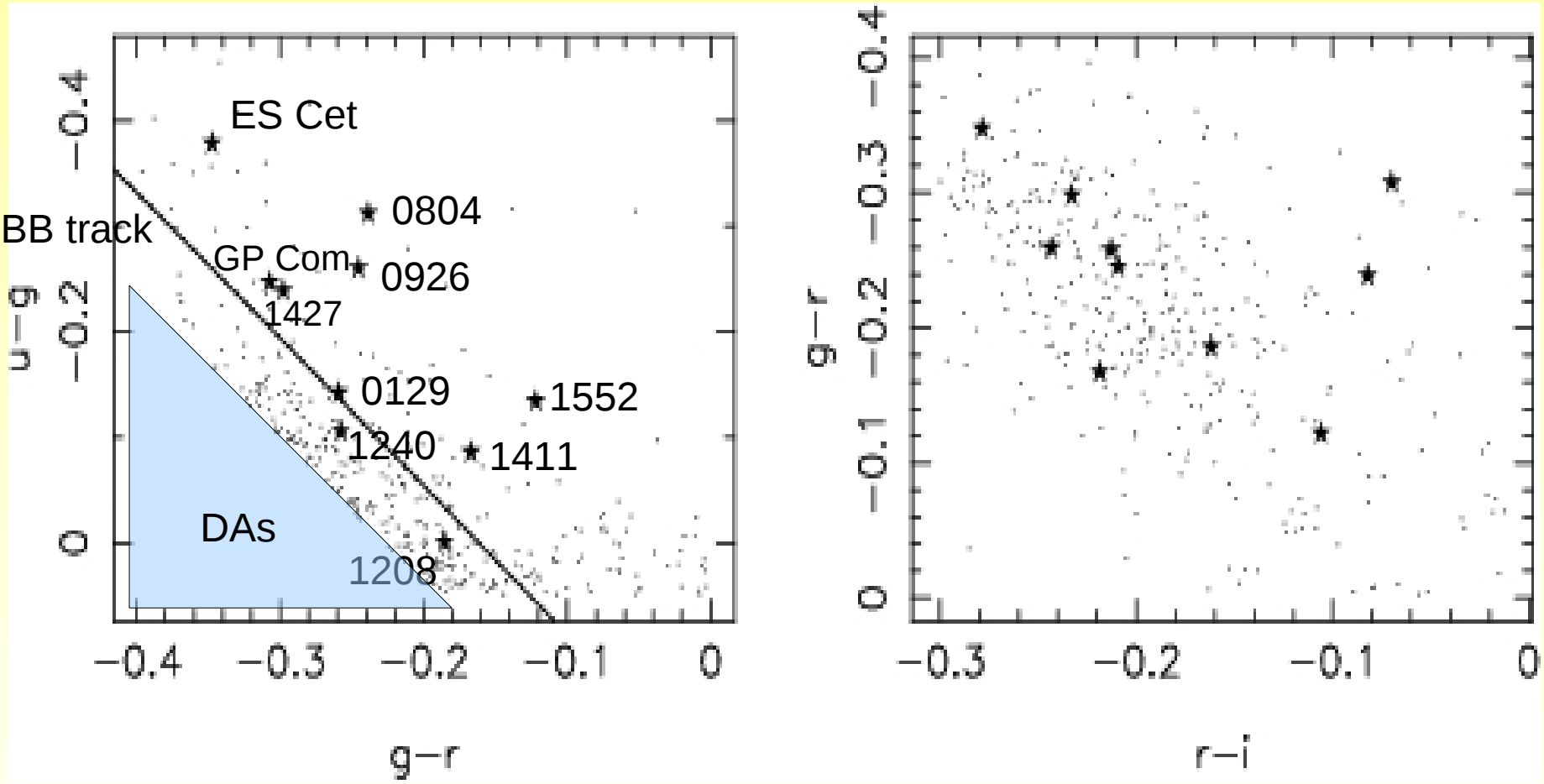


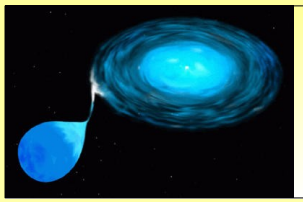
Figure 6. Modelled distribution of spectroscopically identifiable AM CVn stars in SDSS-I as a function of orbital period, along our modelled cooling track. The periods of the 6 detected AM CVns are *not* their measured orbital periods, but their modelled values based on their colours. The solid and dotted lines are the optimistic and pessimistic models, respectively.



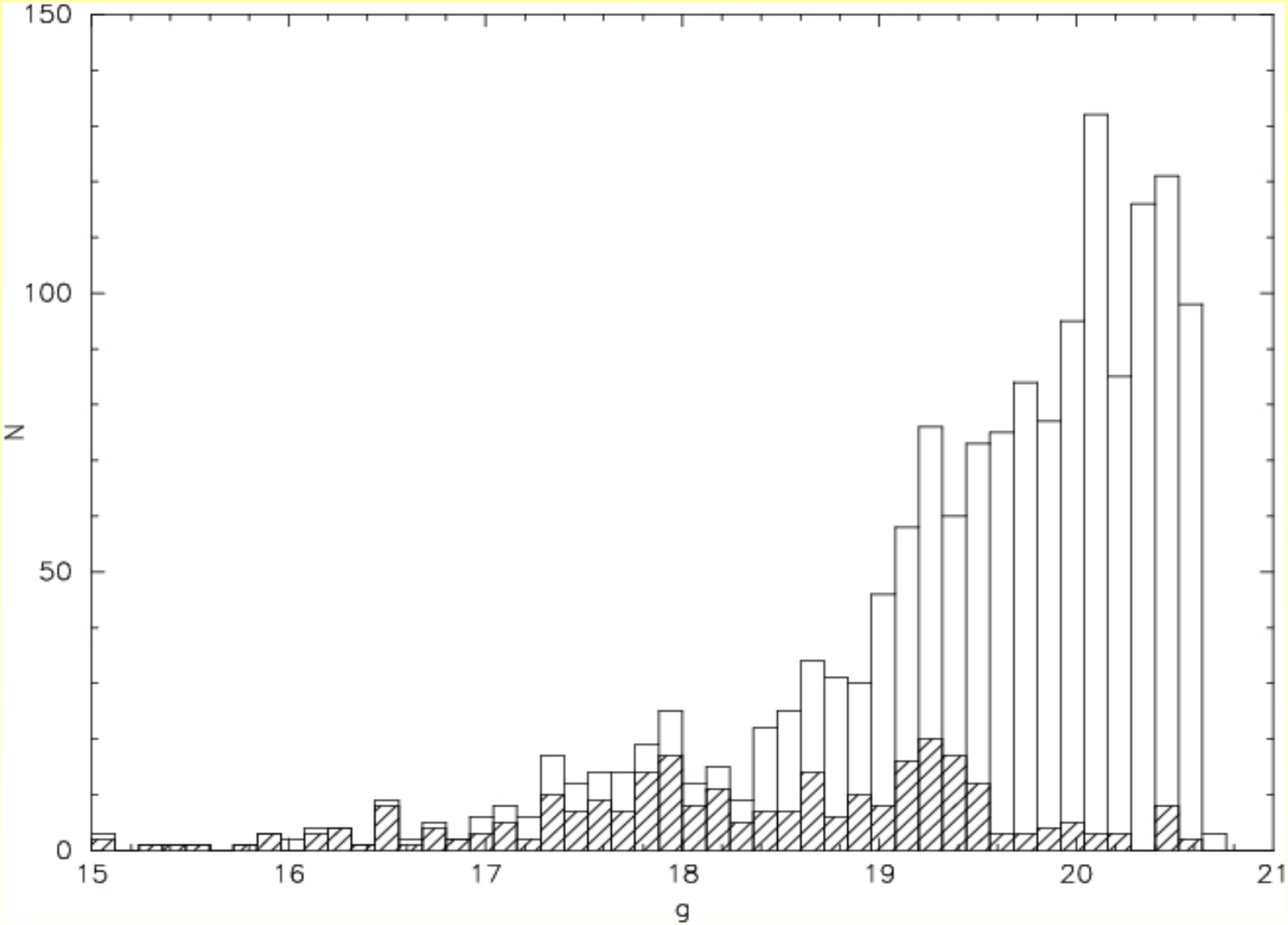
Go Hunt...



~1500 candidate systems from the SDSS (down from 250 million...)

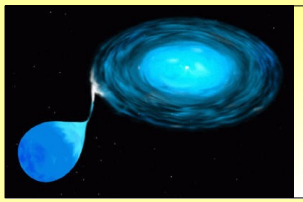


Go Hunt...

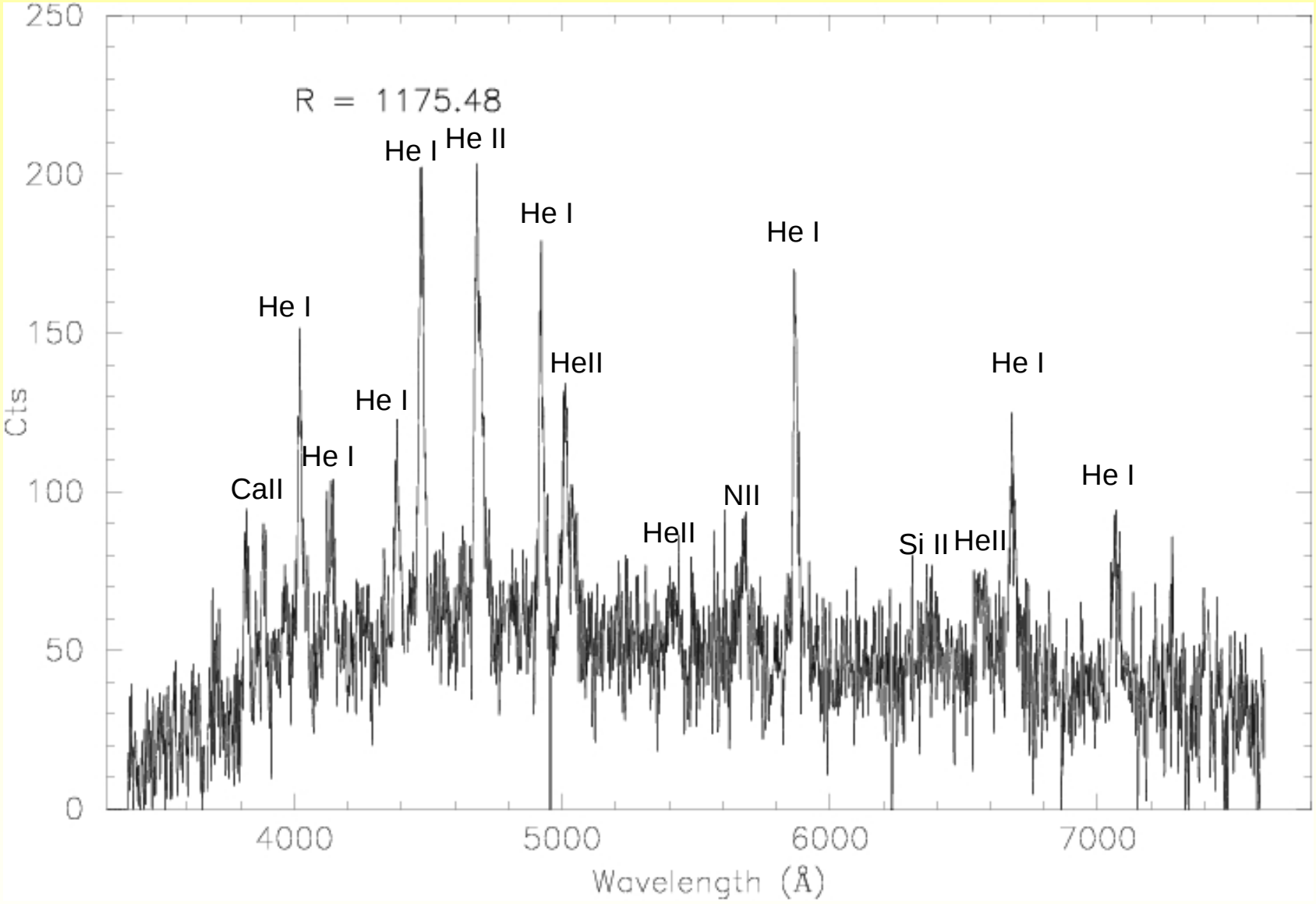


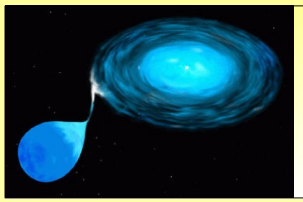
19% done

Ongoing program on 1.5m Tillinghast, INT, WHT, VLT, Keck, Hale



Results:SDSSJ0804+1616





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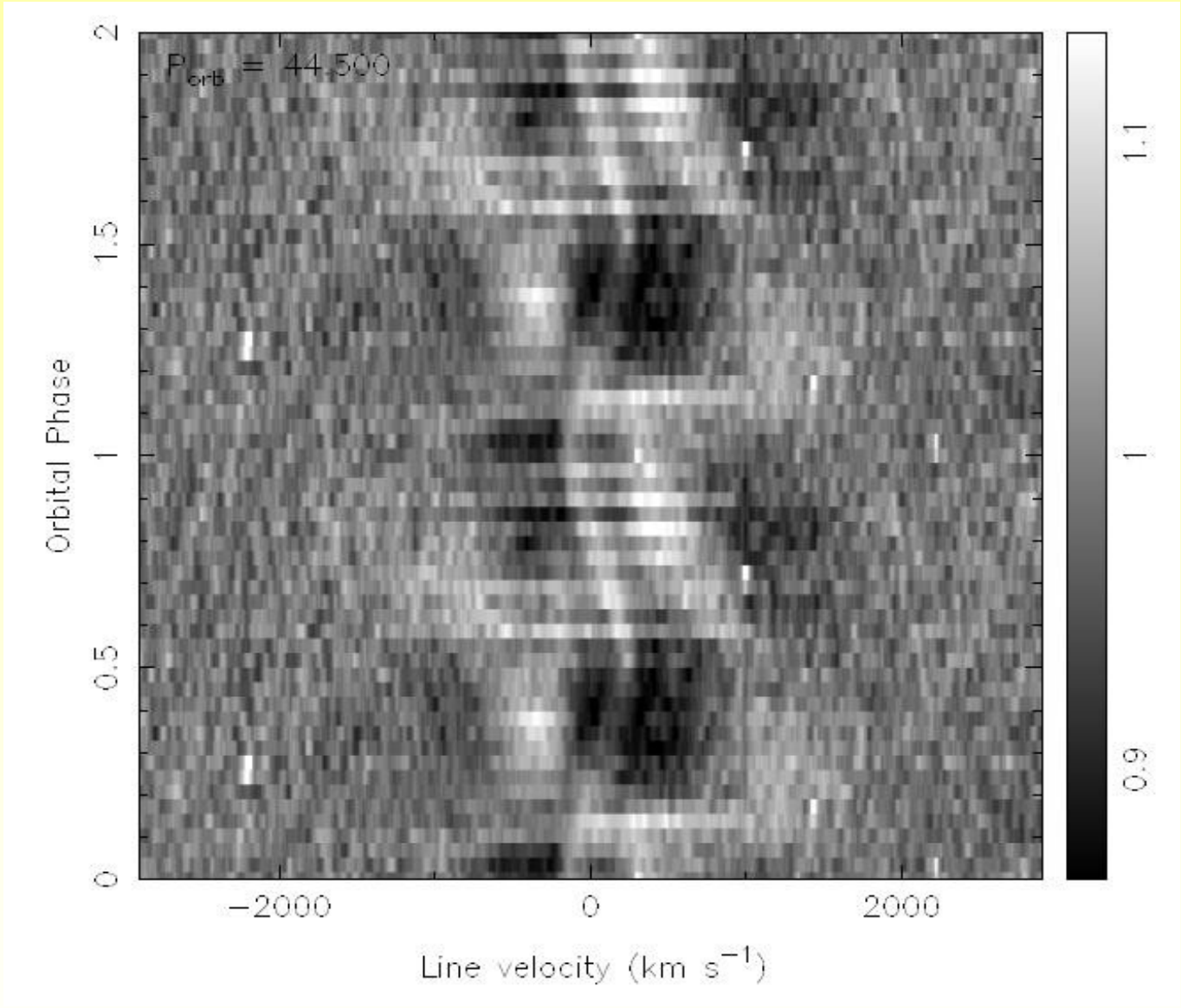
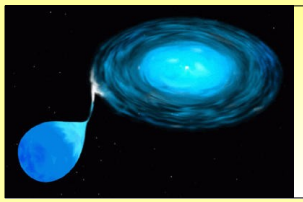
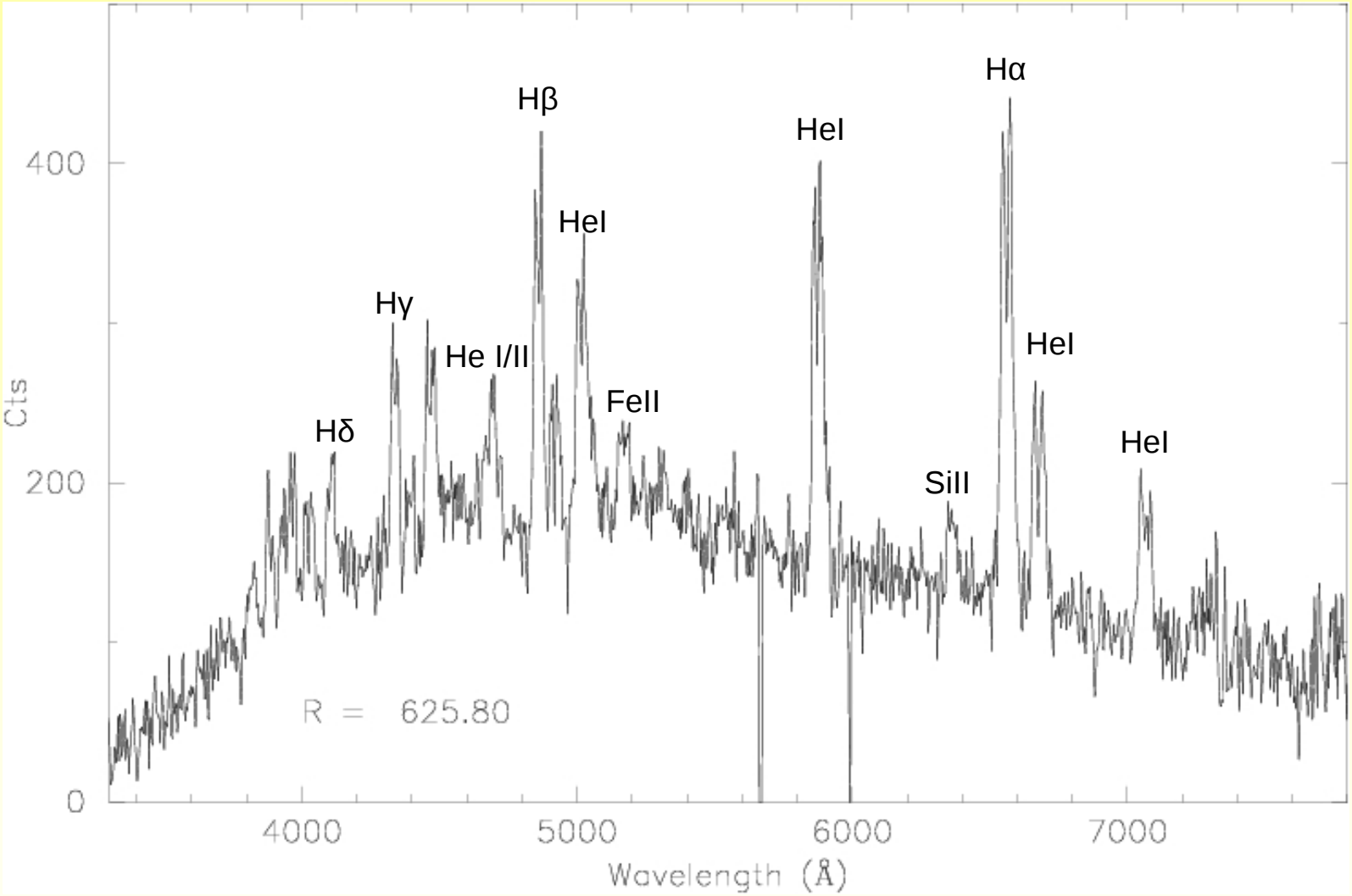


P_orb=44.5 min

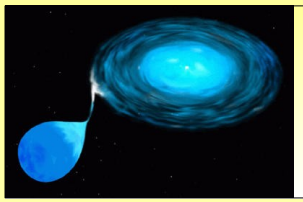
Roelofs et al., 2008



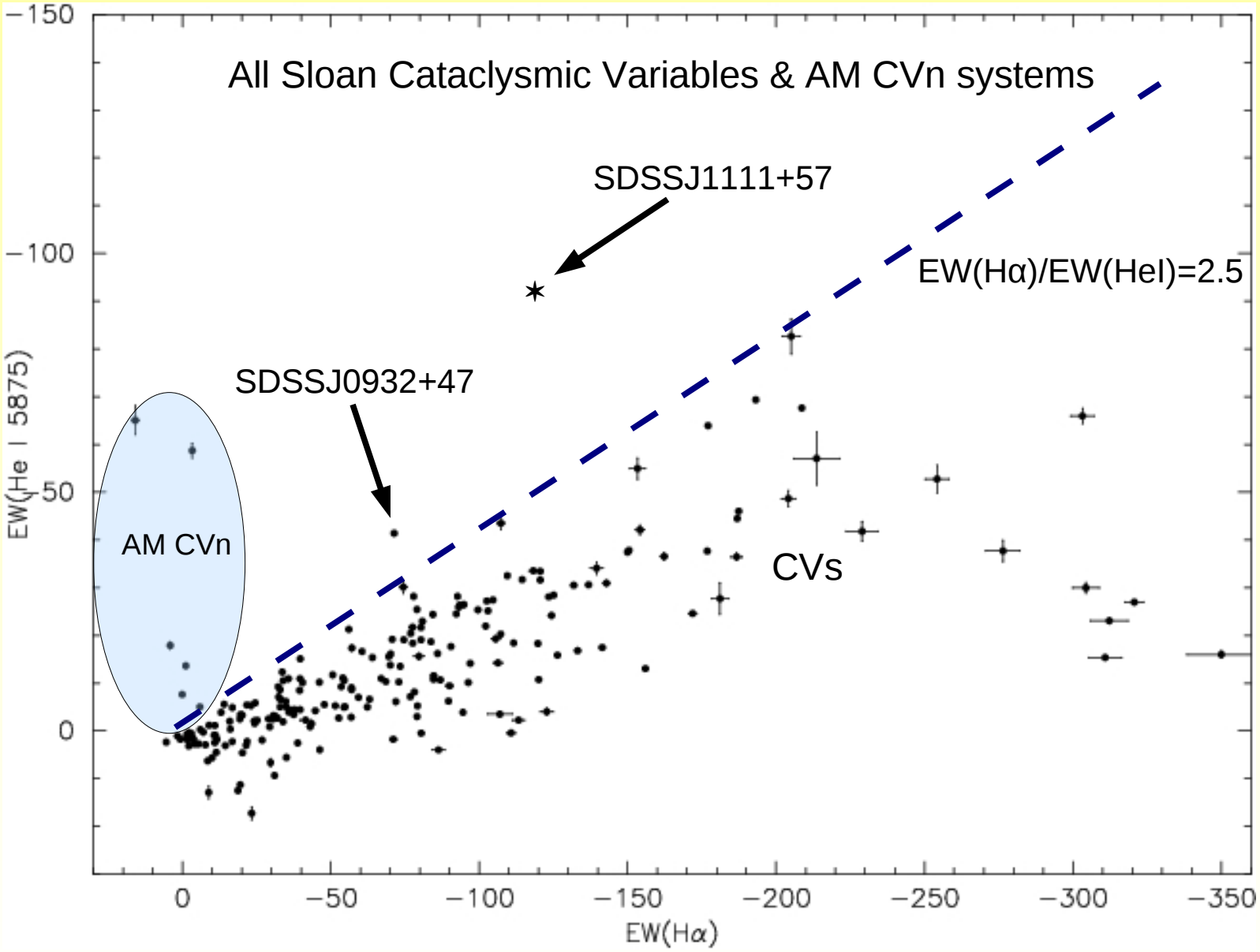
Results:SDSSJ1111+57

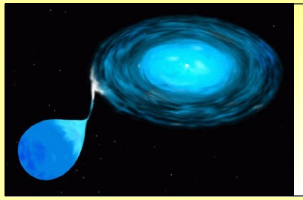


- CV channel?
- Deep central absorption => high inclination?

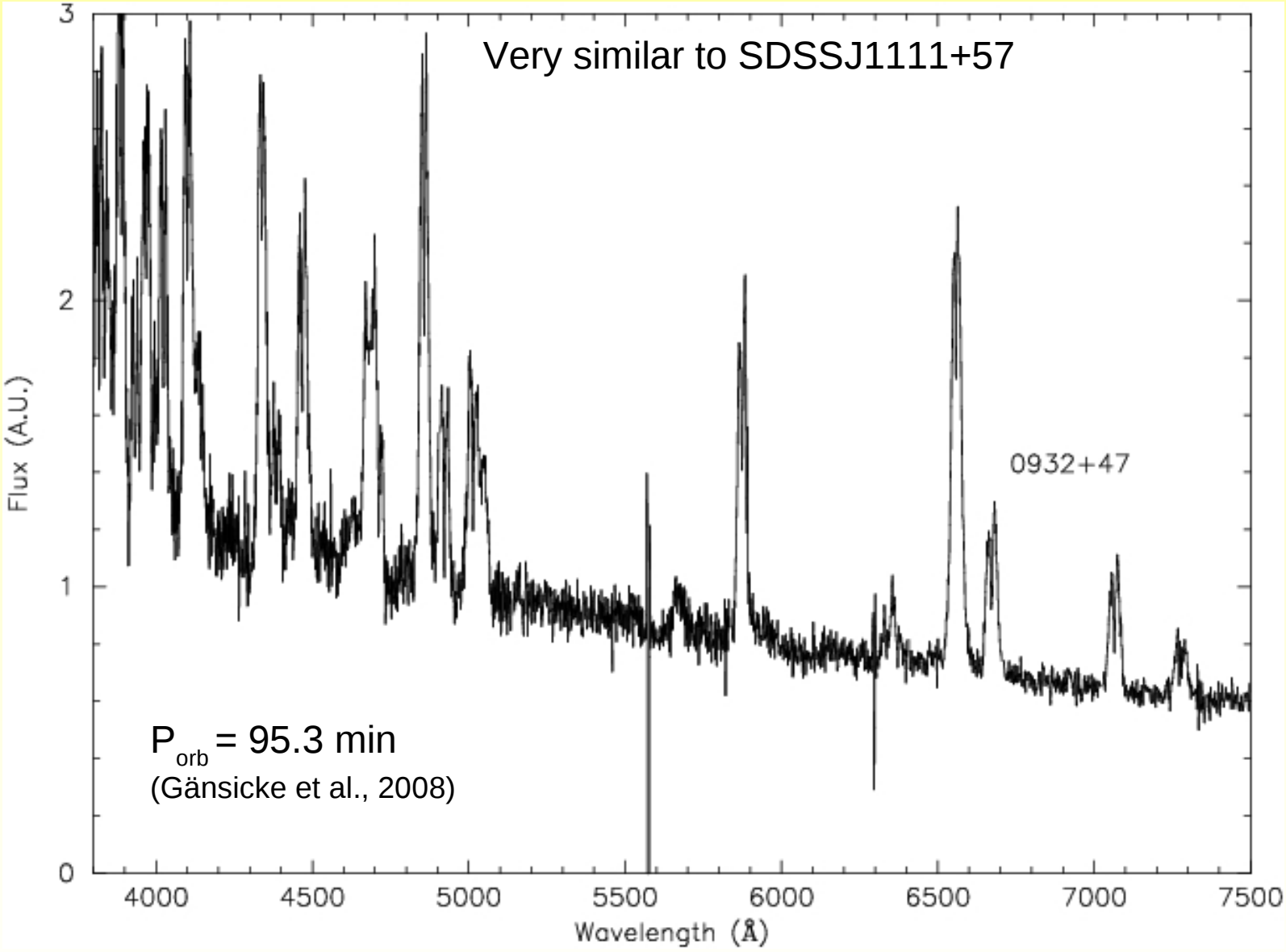


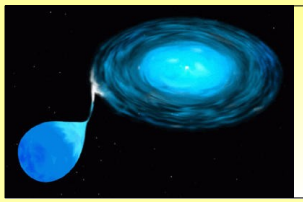
Results:SDSSJ1111+57



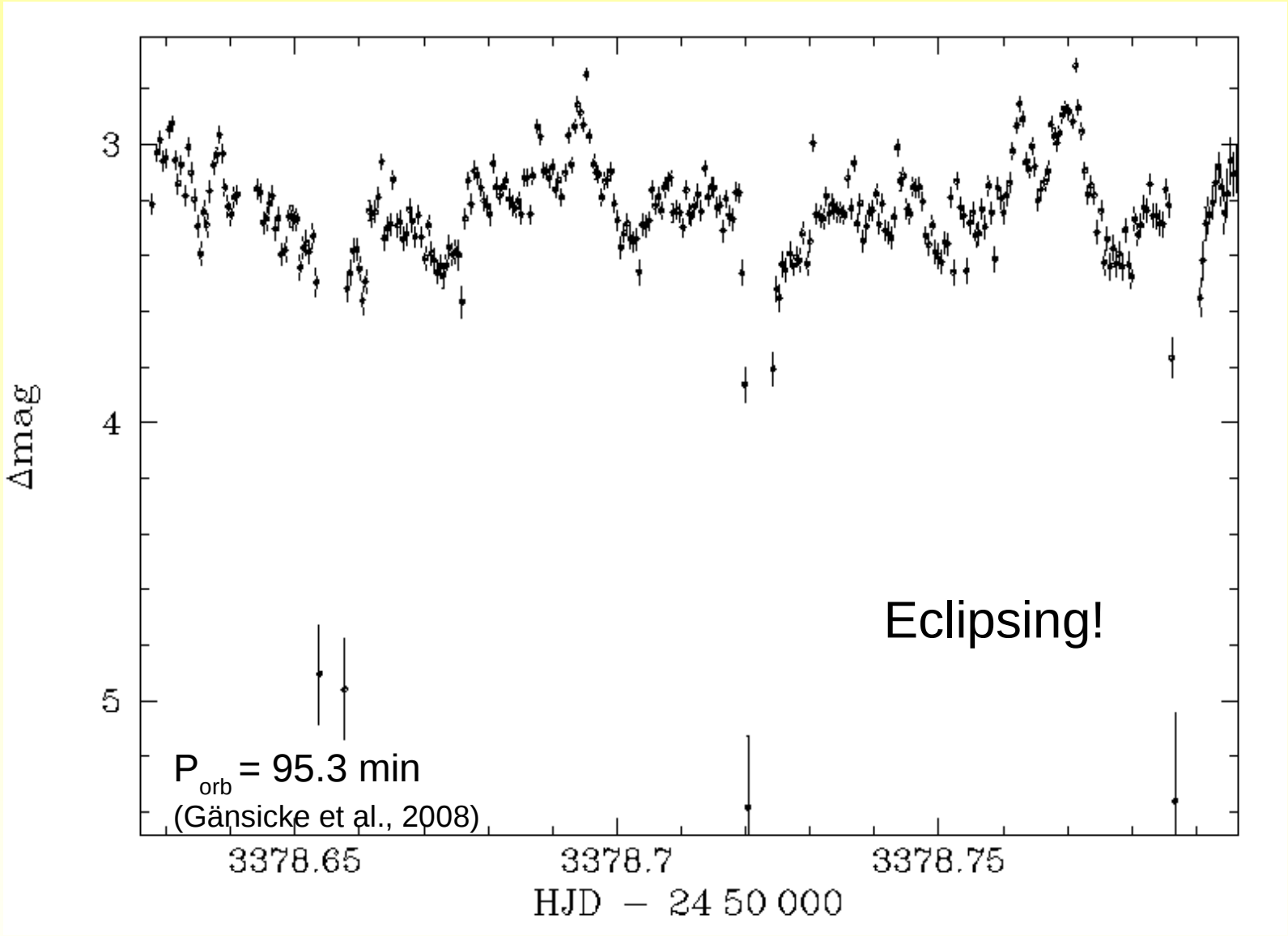


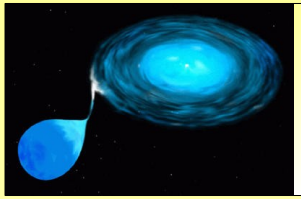
SDSSJ0932+47





SDSSJ0932+47





For the Future

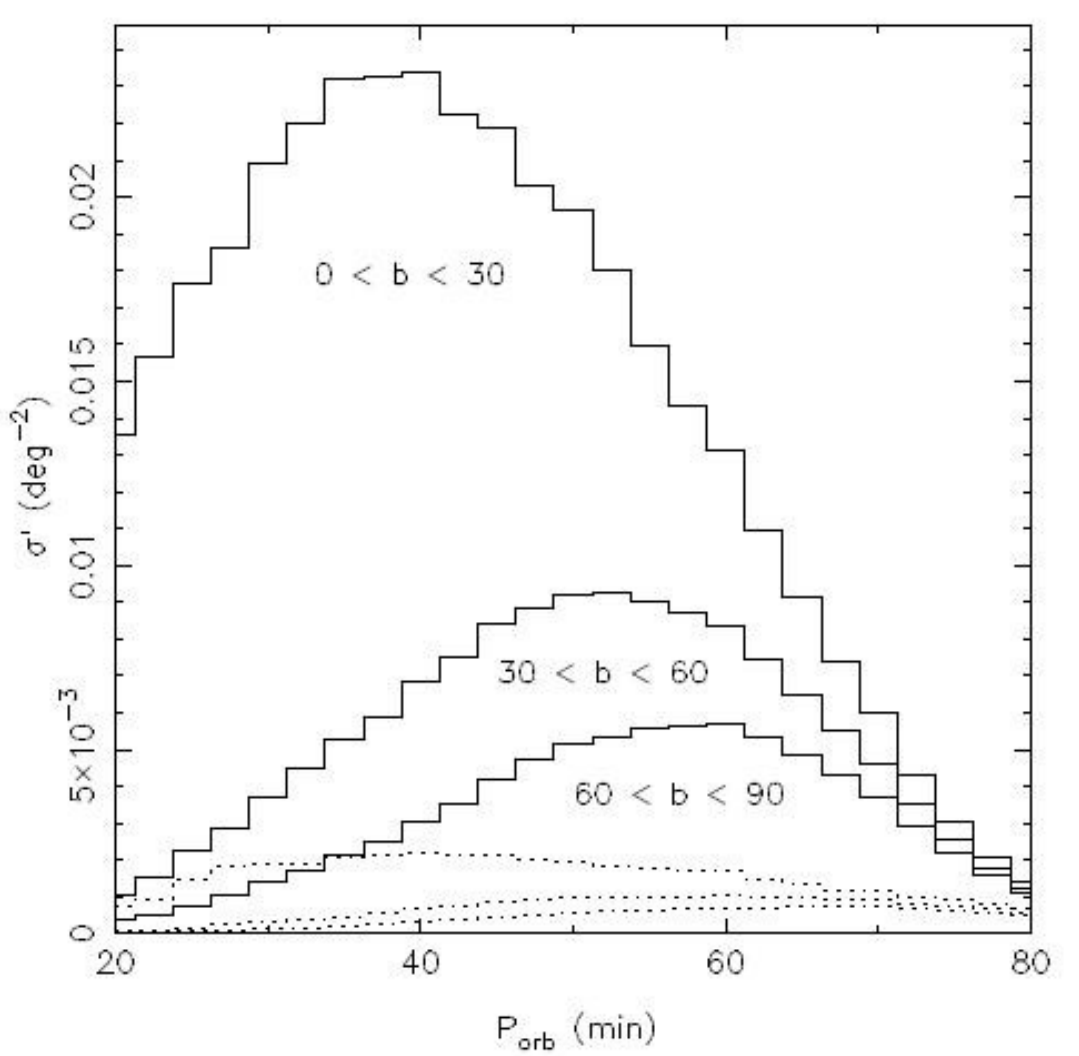
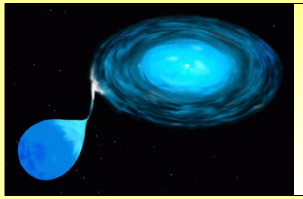


Figure 1. Modelled surface density σ' (per square degree) of AM CVn stars as a function of orbital period, down to $g = 21$, for three Galactic latitude ranges. The solid line shows the 'optimistic' model, the dotted line the corresponding 'pessimistic' model.

Remember that AM CVn stars reside at *low* Galactic latitude!



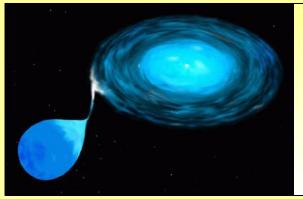
Question 2 from Jan Erik:

Q: Where are the shorter period systems between 14 < m_V< 20?

A: They are not there. Not in Sloan at least.

To Show: Very simple model of observable population of AM Cvn in Galaxy.

- M_V vs. Period relation from Nelemans et al. 2004
- Space density of 2×10^{-6} pc^{-3}
- Constant birth rate since beginning of Galaxy (13.7 Gyr ago)
- Pill-box Galaxy with no reddening and height 500pc



Expected distribution

Probability distribution for N_{galaxy} = 100 and *b*>45